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COVER

The first of Gumman Aerospace Corp.'s two Space Shuttle training aircraft, to be used by NASA to instruct the flight crew in the critical descent and landing phase of the Orbiter, is shown making its maiden flight.

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Monthly NASA Highlights

Wallops Successfully Launches New Sounding Rocket Configuration

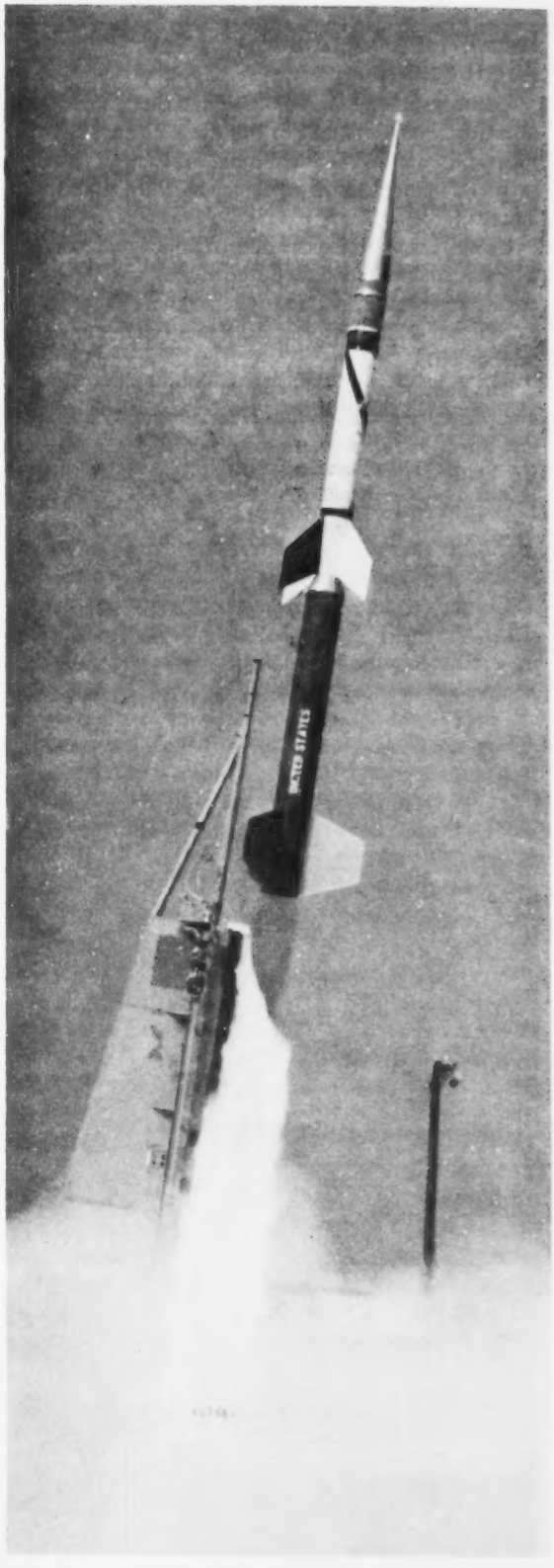
A two-stage solid propellant sounding rocket carrying a 185-pound payload was successfully launched at 3:32 p.m. EDT on Sept. 9, 1975. This Nike-Hawk configuration was the first test of a new system developed by the Wallops Flight Center. Both rocket stages are low-cost, surplus motors.

A secondary objective was the flight test of a newly-developed recovery system for future use with both the single-stage Hawk and the Nike Hawk vehicles. The 14-inch-diameter recovery system is 18 inches long and weighs 50 pounds. It will handle 300 pounds on the parachute and can be reconfigured for land or air recovery.

After reaching a peak altitude of 164 km (102 statute miles), the payload impacted about 178 km (96 nautical miles) downrange in the Atlantic Ocean and was successfully recovered at about 6 p.m. by the research vessel, "Annandale," under contract from the Marine Science Consortium at Wallops Island, VA.

In addition to the vehicle performance instrumentation and recovery system, a piggy-back experiment was carried for the University of Pittsburgh to test a new high-resolution photoelectron spectrometer. This instrument is a new type electron-energy analyzer and was used to measure the daytime photoelectron energy distribution with a very high energy resolution. The design improvements from this instrument flight test will be very important in studies of magnetospheric substorms.

Bobby J. Flowers of Atlantic, VA, was the Vehicle Manager; Carl W. Balance, Jr., of Parksley, Va, the Recovery Systems Manager; Dempsey Bruton of Onancock, Va., Project Engineer; and Dr. E. C. Zipf of the University of Pittsburgh the Project Scientist.



New Sounding Rocket Configuration—The first stage was a Nike M88 (144.5 inches long and 16.5 inches in diameter) rocket motor using the Nike Ajax first stage fins reduced in space to 25.31 inches. The Hawk (210 inches long and 14 inches in diameter) fins were of the same design used on the single stage Hawk sounding rocket; however, the tail can was redesigned to accommodate four fins and an interstage adaptor.

New Propulsion Control System Flight Tested

The first flight of an F-111 with its Integrated Propulsion Control System (IPCS) was made at the Flight Research Center. The new propulsion control system is expected to increase the efficiency of future high speed aircraft.

Using digital electronics instead of conventional hydromechanical controls of the aircraft's supersonic jet engine and engine inlet, the system should allow the plane to be flown at full performance limits without adverse interaction.

The flight was the culmination of 30 months of analysis, design and ground-test and begins the final phase of a three-year contract awarded the Boeing Aerospace Co. by the USAF Aero Propulsion Laboratory. Pilots were NASA's Gary Krier and USAF Major Stan Boyd.

Rocket-Powered Aircraft Makes Final Flight

The only rocket-powered aircraft known to be flying today, the USAF/NASA X-248, made its final flight late in September at the Flight Research Center, ending another era in experimental rocket-powered flight tests.

At the controls was NASA civilian research pilot William H. Dana, who also had flown the HL-10 and M-2 lifting bodies.

The research airplane program was first initiated in 1944 by NASA's predecessor, the National Advisory Committee for Aeronautics (NACA), the USAF and the Navy. Several rocket-powered aircraft have been flight-tested since then, including the X-1, X-1A, X-1B and X-1E, which expanded the limits of manned flight to speeds of 1,500 miles per hour and altitudes of 90,000 feet.

Most successful of the rocket-powered research aircraft was the X-15, which established world records of 354,000 feet altitude and 4,520 miles per hour speed (Mach 6.7), extending the frontiers of aerodynamic flight into space itself.

Tests with rocket-powered lifting bodies, so called because they did not have wings and obtained their aerodynamic lift for flight from their body shape, proved that man could maneuver and safely land lifting entry-type spacecraft on the ground like conventional aircraft.

X-24B Pilots—The three pilots who have flown the X-24B are (left to right) USAF Lt. Col. Mike Love and John Manke and Bill Dana of NASA.

Wind Energy Experts Speak to Press

Early in September, two rotor blades spanning 125 feet were hoisted into place atop a 100-foot tower, completing the 100-kilowatt windmill located at the Lewis Research Center's Plum Brook Station. Members of the news media were invited to observe this event and to interview Louis Divone, Acting Chief of the Wind Energy Systems Branch, Energy Research and Development Administration (ERDA). Also interviewed were Richard L. Puthoff, Lewis Project Manager, and Ronald L. Thomas, Chief of Lewis' Wind Power Office.

The windmill project is a part of the Wind Energy Program at ERDA and will serve to study the potential of wind as an alternative source of energy. Once in operation, the blades will start turning in an eight-mile-per-hour wind and research maximum kilowatt output in a 19-mile-per-hour wind. The experimental windmill is expected to generate enough electricity to power about 30 homes.

Completing a Windmill—Rotor blades measuring 125 feet across are shown as they recently were hoisted onto the 100-foot tower to complete the windmill constructed at the Lewis Research Center's Plum Brook Station near Sandusky, OH.

Special Apollo Soyuz Slogan Cancellation at Greenbelt Post Office

The United States Postal Service approved this particular slogan cancel commemorating the Apollo Soyuz launch:

Nearly 8,000 envelopes were received for cancellation by the Goddard Space Flight Center Stamp Club from space cover collectors in the United States and from foreign countries. This special slogan cancel was first used on the day of launch of the Apollo Soyuz mission and will continue to be used at the Greenbelt Post Office in Maryland until Oct. 31, 1975.

Development of a New Automobile Engine Recommended

A study conducted at the Jet Propulsion Laboratory indicates that development of a new automobile engine can eliminate the automobile as a major pollution source and reduce national automotive fuel consumption by one-third. The new engine could be perfected and introduced to the public by the mid-1980s, according to the study.

The team of JPL engineers was headed by Dr. Rhoads Stephenson and assisted by the Caltech Environmental Quality Laboratory and several consultants. They studied nine types of engines, including the present gasoline engine and its possible improvements. The Brayton (gas turbine) and Stirling (continuous combustion external to working pistons) engines proved most promising. These engines would be virtually pollution free and would boost gasoline mileage by 30 to 45 percent. This reduction in automotive gasoline consumption would yield a savings in crude oil of up to two million barrels per day, a value of about $8 billion a year at current prices.

The Automobile Power Systems Evaluation Study was funded by the Ford Motor Co., with a mutual agreement that JPL would conduct an unbiased study independent of the automobile producer. The study determined fuel economy, emissions, and costs of six sizes of cars powered by the alternate engines, as well as improved versions of the conventional engine. The evaluation took into consideration the public's need for personal mobility, growth of mass transit systems, material resources, air quality, highway safety, and the costs to the automobile industry of converting to a new engine.

In comparing the current engine with the alternates, the JPL team defined an equivalent alternate-engine-powered vehicle concept for each size class of current cars. The cars are equivalent in terms of passenger accommodations and trunk space, acceleration, handling and ride, accessories, durability, safety, and noise levels. Each equivalent car was compared on the basis of fuel economy, emissions, purchase price, and operating costs.

It was found that the Brayton and Stirling engines can be mass produced at a cost differential small enough to be easily recovered in fuel savings by the first owner. Since these engines are not in a form ready for mass production, the study report recommends pursuing the necessary development programs.

Both the Brayton and the Stirling engine concepts have been in existence for many years. Recent technical developments now make both engines extremely promising for passenger car application.

Cotton Named to Senate Space Committee

As the result of a resolution passed by the U.S. Senate to increase the membership of its Committee on Aeronautical and Space Sciences from 10 to 11, Senator Norris Cotton (R of NH) was appointed to the vacancy thus created.

Reliability Systems Symposium Held at MIT

Sponsored by the Ames Research Center, the Massachusetts Institute of Technology recently conducted a three-day workshop on the reliability problems of advanced flight control systems for aircraft.

Object of the workshop was to present new system principles for the use of multipurpose digital computers for active flight control concepts. In active computer control, a digital computer modifies the control motions made by the pilot to improve stability, to reduce loads on the aircraft, to simplify the pilot's tasks, and to compensate for turbulence or other factors affecting flight. For safe flight under active control, however, the computer hardware and the programs stored in its memory (software) must be highly reliable.

Meetings were chaired by Prof. Michael Athans, Director of MIT's Electronic Systems Laboratory, with Brian F. Doolin of ARC as co-chairman.

The symposium was conducted as a part of Avionic's R&T Base research program of the Office of Aeronautics and Space Technology. Forty experts from NASA, universities and industry reviewed the functional and reliability requirements of active flight control and examined current approaches to achieving reliable performance.

The concepts of control and systems engineering relating to the problems were also reviewed. Computer hardware can be made reliable by providing redundant components and through experience gained in the manu-

facture, testing, and use of many computer components. For computer programs or software, the story is greatly different. The science of developing reliable software is in its infancy, and new approaches in system design are needed for progress.

The proceedings of the workshop are expected to be reported in a NASA Special Publication.

This is the second workshop Ames has sponsored to stimulate thought for new principles for control systems organization. Utah State University held a workshop on Large Scale Dynamic Systems in August, 1974, to acquaint researchers in control systems engineering with practical large-scale systems, to examine their common structure, and to learn the methods currently used in their analysis and synthesis. These proceedings have just been published as NASA SP 371.

NASA Technology Goes to Cajun Country

NASA's National Space Technology Laboratories, in cooperation with the Louisiana Technology Transfer Office, is organizing a space technology exhibition and demonstration for the 1975 International Rice Festival in Crowley, LA, Oct. 17-18. Crowley is located in the heart of the colorful and famous Cajun Country of Louisiana, and its Rice Festival attracts a national and international audience. Last year, for instance, it was attended by more than 100,000 persons and was well covered by the news media.

The purpose of the presentation is to illustrate the benefits of space technology in improving the quality of life of all citizens—using lectures in business, civic, and educational groups, as well as literature, as tools. NSTL participants are the NASA/NSTL Applications Engineering Office the NSTL Resident Office of the Louisiana Technology Transfer Office (an arm of the Governor's Office), and the Department of the Interior's EROS Applications Assistance Facility. The Johnson Space Center is assisting by providing LANDSAT, Apollo-Soyuz and Space Shuttle exhibits. Other exhibits are being provided by the Marshall Space Flight Center.

A highlight of the program will be a special exhibit which tells how space technology is being applied by the several cooperating Federal and States agencies at NSTL.

Charles D'Agostino, Director of the Louisiana Office, in residence at NSTL, said:

"We believe this exhibition will give us another opportunity to show the importance of the space program and how it is reaching the grassroots level. Benefits, such as agricultural planning and vegetation stress alerts, medical research, hurricane and storm monitoring, flood predicting, water purification technology, and solar energy applications are actually being put into use in our State through our relationship with the Space Agency. NASA has the technology—the people have problems that can be solved by applying that technology.

"The feedback we receive from citizens visiting the exhibition will also further assist us in finding out more about the people's problems—making our joint efforts even more relevant."

Second Viking Launched Toward Mars

The second Viking spacecraft was successfully launched on Sept. 9, 1975, from Cape Kennedy by a Titan III Centaur launch vehicle. Liftoff was on schedule and all launch events were nominal.

The Viking 2 follows by about three weeks the Viking I launch on America's first attempt to search for life on the surface of another planet. The trajectory correction to target the Viking I for Mars orbital insertion was so accurate that another maneuver will not be required until 30 days before insertion into Mars orbit.

Both spacecraft are operating satisfactorily. The Viking I is scheduled to reach Mars orbit on June 19, and could possibly land on the Martian surface on July 4, 1976. The Viking 2 will orbit Mars about August 7, with a landing scheduled for no earlier than Sept. 4.

New Commercial Communications Satellite Launched

Comsat's Intelsat IVA F-1 commercial communications satellite was launched successfully on Sept. 25, 1975, from Cape Kennedy, FL, by an Atlas Centaur launch vehicle. This spacecraft is the first of a series of improved Intelsat commercial communications satellites that will have almost two-thirds greater communications capability than the present Intelsat IV series.

The International Telecommunications Satellite Consortium, known as Intelsat, is an international joint venture created to establish a global commercial communications satellite system. The Communications Satellite Corporation (Comsat) is a privately-owned U.S. communications carrier company that operates and manages the system for Intelsat. ■■

Did You Know?

NASA has selected Brooks Air Force Base, San Antonio, TX, as the site of a remote storage facility for a portion of the lunar material brought back from the Moon by the Apollo astronauts. Except for lunar samples out on display or under study, all of the material is stored at the Johnson Space Center curatorial facility at Houston.

The Brooks facility is expected to be ready for the samples by the end of December, with sample transfer expected to take place in early 1976.

The only rocket-powered aircraft known to be flying today, the U.S. Air Force/NASA X-24B, made its final powered flight at Flight Research Center Sept. 23, ending another era in experimental rocket-powered flight testing. The craft has been one of this country's most valuable tools of advanced aeronautical research and has made many contributions to future airplanes and to manned space flight.

The Marshall Space Flight Center has asked for proposals for the triennual maintenance and repair of the NASA-owned barge "Pearl River," berthed at the Michoud Assembly Facility at New Orleans.

The fourth in a series of technology transfer seminars for the benefit of minority businesses was held at San Francisco Sept. 11.

Co-sponsored by NASA and the Department of Commerce's Office of Minority Business Enterprise, the aim of the seminars is to share Space Age technology with minority businesses to assist them in developing new products.

Earlier seminars were held at Houston, Los Angeles and Boston.

Several million dollars in research and development funds for a precise pointing system can be saved by using equipment available from the Skylab program, according to engineers at the Marshall Space Flight Center.

They have determined that a Miniaturized Pointing Mount (MPM) which can be used for precise pointing of space sensitive instruments on Shuttle/Spacelab flights could be built by modifying a star tracker pointing system developed for the Skylab Apollo Telescope Mount pointing control system.

Studies also indicate that the five star tracker flight units now in storage at MSFC could be converted to MPMs at a fraction of the cost of new development.

The Boeing Co., Seattle, WA, and the Martin Marietta Corp., Denver, CO, have been selected by NASA for parallel negotiations leading to the award of a contract to one of the companies to provide a base module for the first of the agency's Application Explorer Missions (AEM-A: Head Capacity Mapping Mission).

The goal of the AEMA-A spacecraft is to obtain thermal inertia data related to the Earth's surface. These data will permit discrimination of rock types, location of mineral resources, soil moisture, vegetation cover temperature measurements and similar findings.

Contracts totaling $2,715,477 were awarded to minority businesses by the Marshall Space Flight Center during fiscal year 1975. This was $200,000 more than the MSFC goal of $2.5 million. Not included are sub-contracts awarded to minority businesses by major MSFC contractors. ■■

CVT Test No. 5 Crew—Four of the five crewmen involved in multi-discipline experiments in the General Purpose Lab at the Marshall Space Flight Center, designated Concept Verification Test (CVT) No. 5, are shown here with the equipment each used in the simulated space mission. Left to right, they are Dr. Carter Alexander, of Johnson Space Center, and Dr. Thomas A. Parnell, Harry L. Atkins and James O. Jolley, all of MSFC. A fifth crewman, Larry Wise, was not present when the photo was taken.

NASA Involved In Deciphering Cave Drawings

A team of NASA/university astronomers and U.S. Park Rangers has deciphered a number of ancient Indian "rock art" paintings and petroglyphs in the southwestern United States as possibly commemorating the explosive creation of the Crab Nebula in 1054 A.D.

Each of the paintings found in previously inhabited areas of Arizona, California, New Mexico and Texas includes a crescent moon next to a large star-like object. Calculations by the team verify that western North America is the only place where the supernova (exploded star) that created the huge nebula could have been visible in conjunction with the crescent moon.

According to Dr. John C. Brandt of the Goddard Space Flight Center, "our observations support the celebrated Chinese Sung Dynasty records—the *Sung Shih* —which record the Crab Nebula Supernova as observed from the Far East 921 years ago. These records describe a very bright star which appeared in the sky about 12 years before the Normans' final invasion of medieval England in the famous 1066 A.D. Battle of Hastings."

Ancient Indian "Rock Art"—Dr. John C. Brandt, Head of the Goddard Space Flight Center's Laboratory for Solar Physics and Astrophysics, is shown with examples of ancient American Indian "rock art" that he believes commemorate sightings of the supernova (exploded star) that created the Crab Nebula in 1054 A.D. The bottom photo is of a petroglyph (painting) located near the Village of the Great Kivas in the vicinity of Zuni, NM.

Astronaut Duke to Leave NASA

Astronaut Charles M. Duke, Jr., who logged 265 hours and 51 minutes in space as lunar module pilot of Apollo 16, has announced that he will resign from NASA, effective Jan. 1, 1976.

Without revealing his plans for the future, he said he also will resign from the U.S. Air Force after 18½ years of service. He is a colonel.

On the Apollo 16 mission in April, 1972, Duke and Astronaut John W. Young landed in the Descartes region of the Moon for a 71-hour, 14-minute stay, including three surface explorations of the lunar highlands totaling 20 hours and 15 minutes.

Since 1973, Duke has been assigned to the Space Shuttle program, serving as technical assistant to the Manager for Space Shuttle Systems Integration. His departure from NASA will reduce the number of astronauts to 29.

Fernandez Named to Replace Ray Kline

Col. Gonzolo Fernandez, USAF (Ret.), has been appointed to the position of Assistant Associate Administrator for Center Operations (Systems Management), left vacant when Ray Kline was named Assistant Administrator for Institutional Management.

Fernandez will be responsible for the Offices of ADP Management, Information Systems, NASA Aircraft, Safety and Environmental Health, and Operating Systems. It will be his responsibility to provide agency-wide functional management in these areas, as well as to provide a business computer capability for NASA Headquarters.

A former B-47 aircraft commander who served in numerous Air Force assignments in the field of computer management, Fernandez more recently has been Director of Information Systems at Andrews Air Force Base.

Smithsonian to Get Backup Skylab Hardware

Several pieces of space station hardware, built for but not used in the Skylab program, are being prepared for shipment to the Smithsonian Institution by the Marshall Space Flight Center.

An Orbital Workshop, core of the Skylab cluster, an Airlock Module and Multiple Docking adapter, with all equipment removed which can be used in current programs such as the Space Shuttle and Spacelab, will be displayed at the Smithsonian's new National Air and Space Museum, set to open July 4, 1976.

The Skylab hardware will leave MSFC by Oct. 31 and will be barged from Florida to Washington, arriving by Nov. 20. The Workshop will then be disassembled, placed in the Museum, and then reassembled.

Senate Group Briefed on Aircraft Fuel-Saving Programs

A proposed government-sponsored research effort aimed at providing the technology for a 40 to 50 percent reduction in fuel consumption by civil aviation transport aircraft was outlined recently before the Senate Committee on Aeronautical and Space Sciences.

The presentation was made by Dr. George M. Low, NASA Deputy Administrator, and other representatives of the agency.

Efforts of industry, combined with the results of a vigorous NASA research program, the committee was told, could result in substantial improvement in the efficiency of air transport fuel use, without degrading the environment or reducing aircraft safety.

The plan outlined was the outcome of a study conducted by a group of government scientists and engineers from NASA, the Department of Transportation, Federal Aviation Administration, Department of Defense and industry at the request of Senator Frank E. Moss (D-Utah), chairman of the committee, and of its ranking minority member, Senator Barry Goldwater (R-Arizona).

According to the Federal Energy Administration, the United States paid $3 billion for imported oil in 1970 and $24 billion in 1974. If the situation is not changed, this sum could rise to $32 billion in 1977.

The Air Transport Association estimates that each one-cent-per-gallon increase in jet fuel costs the airline industry an additional $100 million per year. The average cost-per-gallon rose from 12 cents in June, 1973, to 29 cents in June, 1975, which reflects the impact on airlines.

Through successful technology development and implementation in the civil air fleet, NASA estimates that, based on a 5.4 percent passenger growth rate, a million barrels of refined aircraft fuel could be saved per day by the year 2005. Six major research programs were defined in the plan laid before the committee. Three of them are evolutionary improvements in aerodynamics and propulsion technology, while the other three—turboprops, laminar flow control, and composite primary aircraft structures—would represent attempts to develop radically different technology from that currently used in civil air transports.

The six programs follow:

Engine Component Improvement—an effort directed at developing improved engine components that could be used on new production of existing engine types and on newly designed engines. They are expected to be ready for use on engines produced in 1980 and could lead to an estimated five percent decrease in engine specific fuel consumption.

Fuel Conservative Engine—a technology base for achieving higher thermodynamic efficiencies in future engine designs, estimated to achieve a 10 percent lower

fuel consumption. Engines using this technology would be expected to be ready for use on new aircraft introduced into service about 1990.

Fuel Conservative Transport—designed to bring about evolutionary improvement of aerodynamic design and the development of active aircraft controls technology. Fuel savings of from 15 to 20 percent are expected.

Turboprops—preliminary performance calculations indicate fuel savings of 15 to 20 percent by designing higher propulsion efficiency into propellers. Performance of propeller-driven aircraft at speeds and altitudes approaching those of current jet transports is a concept.

Laminar Flow Control—one of the technology elements with the greatest potential for fuel savings is drag reduction by laminar flow control. The concept involves removing the surface air boundary layer by section in order to maintain laminar (non-turbulent) air flow and the low drag associated with such flow. Technology is not expected to be available before 1985, as the system could only be incorporated into a completely new aircraft design. Fuel savings of from 20 to 40 percent are anticipated.

Composite Primary Structures—use of composite materials incorporating lighter weight non-metals in primary structural components of aircraft, thus offering substantial vehicle weight-saving possibilities. As compared with present all-metal aircraft, the program may translate into fuel savings of from 10 to 15 percent.

MSFC Seeks Proposals for Cloud Physics Lab Study

The Marshall Space Flight Center has issued a request for proposals from the aerospace industry for a study leading to definition of an atmospheric cloud physics laboratory.

Two parallel firm-fixed-price contracts are planned for the 12-month study, which will be the final definition and preliminary design study for the initial Atmospheric Cloud Physics Laboratory (ACPL) planned as a payload aboard the Spacelab. It will be carried in the pressurized module of Spacelab and will be capable of use on at least two missions per year.

House Committee Staff Visits MSFC—Three members of the staff for the House Committee on Science and Technology recently visited the Marshall Space Flight Center and were greeted by its Director, Dr. William R. Lucas (seated, left). Shown with him are (seated) James E. Wilson, staff technical consultant; (standing, left to right) Robert Lindstrom, Manager of the MSFC Shuttle Projects Office; Darrell Branscone and Thomas N. Tate, staff technical consultants; and Robert V. Lottmann, Office of Legislative Affairs, NASA Headquarters.

Award Winners Attend ASTP Launch

The seven winners of the NASA competition at the 1975 International Science and Engineering Fair and the teachers selected by each of them to share in the awards were guests at the Apollo Soyuz Test Project launch from the Kennedy Space Center.

While there, the group was joined by Richard Foch, a 1974 award winner, and Michael Alpers, a German exchange student who was one of the Viking Student Project winners. In addition to viewing the launch, the group was conducted on a tour of the KSC facilities.

Winners and teachers follow:

Randy C. Elliott and Marion Nottingham, Duncan, OK; Joan C. Heuchart and Freeman Melsted, St. Thomas, ND; Kenneth W. Holappa and William M. Somero, Virginia, MN; John C. Holmes and Jerome H. Fischer, Milwaukee, WI; Mark Lacas and Robert Kitson, Syracuse, IN; William Rojas and Mrs. Johnnye L. Griggs; and Sheldon Tieszen and Carl Boyington, Ogden, UT.

Astronaut Worden Resigns from NASA

Alfred M. Worden, Chief of the Ames Research Center Applications Division and veteran of the Apollo 15 mission, retired from government service early in September.

On duty with NASA as a U.S. Air Force lieutenant colonel, he will enter civilian life after 20 years of federal service, during which time he served as a jet fighter pilot, a test pilot, and a NASA astronaut who went to the Moon.

"I am proud of my association with NASA and with my part in the Apollo program," Worden said. "The most enduring impact of the manned space program may be the concept of a finite Earth or 'Spaceship' Earth.

"For the next year, I intend to travel the country with my family, lecturing on 'Spaceship' Earth and writing a book. To further these ends, I have accepted a position as vice-president with the High Flight Foundation of Colorado Springs, CO."

After coming to Ames Research Center in 1972, Worden has served as a research scientist in the Airborne Science Office, as Chief of the Systems Studies Division, and more recently as Chief of the Applications Division.

83 Awards Are Presented for ASTP Efforts

Both Individuals and Groups are Lauded in Ceremonies at JSC, KSC and MSFC

A total of 83 awards were presented individuals and groups—"whose outstanding efforts and skills contributed significantly" to the success of the Apollo Soyuz Test Project—in separate ceremonies at the Johnson, Kennedy and Marshall space centers on Sept. 16.

The presentations were made by Dr. James C. Fletcher, NASA Administrator, assisted by Dr. George M. Low, Deputy Administrator, and by the Directors of the respective Centers, Dr. Christopher C. Kraft, Lee R. Scherer, and Dr. William R. Lucas.

"This joint venture in manned space flight by the nationals of two sovereign states—the United States and the Soviet Union," Dr. Fletcher said before presenting the awards, "is a landmark achievement that underscores this nation's progress toward the fulfillment of our goal of international cooperation in space exploration as set forth in the Space Act of 1958.

"During the ensuing 17 years, consistent with this mandate, we have shared with virtually all nations the scientific data gained from our advances in space and made available to all the benefits from our weather, communications, and LANDSAT earth resources satellites.

"We have joined with more than 50 nations in a wide variety of unmanned space experiments searching out the mysteries of the solar system and the universe around us.

"We also have trained many scientists from other countries in the ways of space exploration; and we have launched for other nations their own spaceloads with our rockets.

"This comprehensive program of international cooperation which we have pursued so actively for nearly two decades demonstrates clearly, I believe, that space exploration offers the greatest opportunity in the history of the human experience for joint participation by all nations on Earth.

"We have come a long way since 18 years ago the launch of the first Soviet Sputnik opened up the Space Age and triggered the race for the peaceful conquest of space between the United States and the Soviet Union. The U.S. landing on the Moon six years ago pretty well ended that race. Apollo Soyuz symbolizes a new era—not of competition but of cooperation. This program may become a springboard, not only for future cooperation between our nations in *space* but for real advances in cooperation on Earth that will extend to all nations. Such forward movement internationally may move us closer

ASTP Officials Visit MSFC—Standing-room-only crowds attended the recent ASTP award ceremonies at the Kennedy, Marshall and Johnson space centers. At MSFC, Dr. James C. Fletcher (far right), NASA Administrator, presented 23 awards to personnel and contractors. Pictured with him on the stage during the ceremony (left to right) are Astronauts Vance Brand, Deke Slayton and Tom Stafford; Chester M. Lee, NASA's Program Director for ASTP; John F. Yardley, NASA Associate Administrator for Manned Space Flight; and Dr. George M. Low, Deputy Administrator.

to the fulfillment of the dream of peace on Earth that still cludes us."

The awardees follow alphabetically by Center:

Johnson Space Center

Group Achievement Awards—ASTP Experiments Team, ASTP Language Team, ASTP Project Operation Team, ASTP Television Team, ASTP Working Group O, ASTP Working Group 1, ASTP Working Group 2, ASTP Working Group 3, ASTP Working Group 4, ASTP Working Group 5, ATS-6 Tracking Satellite Communications Relay Team.

Public Service Award—Ray F. Larson.

Exceptional Service Medal—Reinhold H. Dietz, Walter W. Guy, Bennett W. James, Frank C. Littleton, Jr., James E. Mager, Leonard S. Nicholson, J. C. Waite, Douglas P. Ward, Robert D. White.

Exceptional Scientific Achievement Medal—R. Thomas Giuli.

Outstanding Leadership Medal—Arnold D. Aldrich.

Distinguished Service Medal—M. P. Frank, III.

Kennedy Space Center

Group Achievement Award—Department of Defense Manned Space Flight Support Office; ASTP Communications Team; ASTP Experiments Team; Launch Accessories Branch, Mechanical Design Division; Systems Operation Section, IN-MSD-12, Measurement Systems Division.

Public Service Group Achievement Award—Boeing Space Vehicle Operations Support Group, Field Operations and Support Division, Boeing Aerospace Co.; CISS Project, Scientific Development Branch, Federal Electric Corp.; Structural Section, Planning Research Corp.

Public Service Award—George R. Faenza, Frank A. Fisher, Robert J. Walker, Claus T. Wiedemann.

Exceptional Service Medal—John H. Bell, E. Jean Bollinger, Bobby F. Bundy, Billy H. Childers, William R. Durrett, Jesse R. Gulick, Charles T. Hollinshead, James L. Hopfinger, Frank W. Horn, Jr., Frank W. Horner, Jr., Frank S. Howard, Darleen A. Hunt, Glenn B. Jeffcoat, Edwin C. Johnson, Claude S. Moses, Conrad G. Nagel, George A. Robinson, Raymond O. Stinson, Joseph L. Stoeckl.

Outstanding Leadership Medal—Gen. Donald M. Hartung, USAF, Walter J. Kapryan, William H. Rock.

Distinguished Service Medal—George F. Page.

Marshall Space Flight Center

Group Achievement Awards—ASTP Experiments Team, Stress Corrosion Review Team.

Public Service Award—Jerry R. Johnson, Willis L. Kilgore, Lorenzo P. Morata, John F. Patrick, Russell H. Ross, William J. Sasiela.

Exceptional Service Medal—William R. Adams, Robert P. Baker, Calvin B. Blevins, Kenneth W. Colley, James L. Crafts, Preston B. Dickerson, Curtis D. Hanks, Charles E. Houston, Fred Jankowski, James E. Ladner, John E. Levinson, Larry E. Marshall, Harold H. Scofield, Larry A. Weaver.

Distinguished Service Medal—Ellery B. May.

Program to Study 'Red Tide' Onset

The first long-range, space-assisted program to attempt to identify the onset of "red tide," an ocean-borne organism that leaves tons of dead fish rotting on beaches in coastal estuarine waters, has been approved by the Florida Department of Natural Resources and the Goddard Space Flight Center.

Recent results obtained with ocean color scanner instrumentation developed at Goddard have demonstrated the capability of detecting subtle variations in the color of coastal waters.

Experts believe that these color variations can be used to determine changes in concentration and species of marine phytoplankton (plant-animal) populations, especially the red tide dinoflagellate, *Gymnodinium breve*. In addition, the color scanner will be used to detect suspended sediments, dissolved solids, and some water pollutants.

"Program managers hope that photographic flights by NASA's U-2 aircraft, by lower-flying planes, and by electronic scanning by LANDSAT spacecraft, in conjunction with on-site sampling of oceanic waters from research ships, will lead to the development of techniques for an early warning system for red tide invasions, or "blooms." Such a system would provide enough warning time to allow authorities to delineate the actual extent and magnitude of a red tide occurrence. That information would be available in time to permit crews to combat effects of a red tide and inform the public about beach areas that could be affected.

In the past, reports of dead fish littering Florida beaches have had an adverse effect on tourism. A red tide outbreak in the spring and summer of 1971 was estimated to have cost the state $20 million or more, primarily in lost tourist business.

Red tide not only occurs off Florida, but also can be a major problem in other parts of the world, including Maine, Massachusetts and California. Fish decomposition can deplete the water of much of its oxygen, and toxic particles produced by the organism can cause eye and respiratory irritations in people. The toxin also affects shellfish, which may store it in their bodies. As a result, shellfish beds often have been closed for several months by state health authorities.

NASA Participates in Underwater Study

Research ships and NASA spacecraft recently joined forces in an experiment conducted by Capt. Jacques Cousteau, famous ocean explorer, to collect information on uncharted underwater features which it is believed could be of significant aid to maritime traffic and marine science in detecting changes in depth and other effects brought about by severe storms and other natural phenomena.

Cousteau's vessel, *Calypso*, working with the research vessel, *Beayondan*, from the Johns Hopkins Applied Physical Laboratory at Laurel, MD, gathered material on ocean bathymetry while stationed at a number of sites in the central Bahamas. Scuba divers working around the boats used special instruments to measure ocean floor reflectivity and water transparency.

Meanwhile, sensors aboard NASA's Earth-Orbiting satellite LANDSAT 2 "looked" through ocean layers at the test site and measured water depths at various widely-separated points. Comparisons later were made between on-site data and those collected via satellite.

Communications with the surface vessels, set up by the Goddard Space Flight Center, were relayed through NASA's Applications Technology Satellite 3, located 35,900 kilometers (22,300 miles) above the equator. Data were transmitted directly to GSFC for analysis.

Dr. Walter Williams Returns to NASA

Dr. Walter C. Williams, the first Director of the Flight Research Center, has returned to NASA in the position of Chief Engineer.

In his new capacity, Dr. Williams, who directed early rocket airplane test flights and manned space missions, will be responsible for reviewing technical excellence of all programs and will report directly to the Administrator.

Dr. Williams returns to NASA from The Aerospace Corp. at El Segundo, CA, where he was Vice President and General Manager of the Vehicle Systems Division. He began his employment there in 1964, after 24 years with NASA and its predecessor organization, the National Advisory Committee for Aeronautics.

Dr. Lovelace Elected Fellow of AAS

Dr. Alan Lovelace

Dr. Alan Lovelace, Associate Administrator for the Office of Aeronautics and Space Technology at NASA Headquarters, has been elected a Fellow of the American Astronautical Society (AAS) for his distinguished scientific and administrative contributions to astronautics and aeronautics.

In his capacity at Headquarters, he directs NASA research and technology development programs to meet the nation's future requirements in aeronautics and space.

The AAS, a professional scientific and engineering organization, is dedicated to the advancement of the astronautical sciences and to furthering the progress of space exploration and exploitation by encouraging exchange of ideas and information among scientists and engineers.

Dr. Lovelace, a native of St. Petersburg, FL, began his career as a lieutenant in the U.S. Air Force and was stationed at the Polymer Branch of the Air Force Materials Laboratory, Wright Patterson Air Force Base, Ohio. After leaving the Air Force, he remained with the Laboratory in a civilian capacity and, in 1967, was named its Director. In 1972, he was made Director of Science and Technology for the Air Force Systems Command.

Prior to his current NASA appointment, he was Acting Deputy Assistant Secretary of the Air Force for Research and Development.

New Star-Tracking Equipment Underway at JPL

A new star-tracker, called "STELLAR" (for Star Tracker for Economical Long Life Attitude Reference), is under development at the Jet Propulsion Laboratory for use in a variety of manned and unmanned mission applications, the first of which will be in connection with an aircraft telescope experiment designed as a precursor to the Shuttle Infrared Telescope Facility being developed at Ames Research Center.

STELLAR uses a solid state silicon detector called a CCD (Charged Coupled Device) for image sensing and a microcomputer to process and organize the data. This approach, expected to involve substantial cost savings in flight hardware procurement, offers the major advantages of all solid state circuit reliability and easy adaptation to varying mission requirements by simply re-programming the microcomputer.

Payroll Savings Plan Award—Vice President Nelson A. Rockefeller (right) on Sept. 10, 1975, presented the Treasury "Liberty Bell Award" to NASA and 20 other agencies for excellent achievement in attaining participation of 70 percent or more in the Payroll Savings Plan during the recently-concluded Federal Bond Campaign. H. Frank Hann, Vice Chairman of the NASA campaign, is shown accepting the award for the agency.

Present star trackers use high voltage vacuum tube image dissectors for image sensing. These tubes are difficult to produce, have limited lifetime, develop errors in the deflection circuitry, and generally can provide attitude reference data from only a single star in any given observation frame. In STELLAR, a single low-voltage CCD clip is used to replace this complex and relatively expensive tube.

CCDs are newly-developed imaging devices which are expected to revolutionize television camera design, resulting in miniature, low-cost home monitors within the next several years. They incorporate a matrix of light sensitive elements formed on the surface of a silicon chip measuring typically six millimeters (¼ inch) on a side. Microcircuits on the chip "read out" the picture periodically, element by element, providing a serial data stream.

STELLAR will provide star-trackers for planetary Mariner spacecraft subsequent to Mariner-Jupiter-Saturn in 1977 and to ARC for use in development of telescope pointing systems planned for such uses as the proposed Shuttle Infrared Telescope Facility (SIRTF), a Shuttle payload now envisioned for the early 1980s. In the SIRTF application, STELLAR would track up to 10 stars simultaneously, providing position coordinates and star magnitudes for each, thereby enabling three-axis stabilization and remote star field recognition.

Lunney to Head Shuttle Payload Office

Establishment of a program office to plan and develop payloads for the Space Shuttle has been announced by the Johnson Space Center.

It will be known as the Shuttle Payload Integration and Development Program Office and will be managed by Glynn S. Lunney, formerly Apollo Spacecraft Program Manager and U.S. Technical Director for the Apollo Soyuz Test Project, who will report to Dr. Christopher C. Kraft, JSC Director.

The Apollo Spacecraft Program Office has been abolished. Personnel from that office and from the Payloads Coordination Office have been reassigned to the new program office, which will manage JSC's integration and operations activities for all Shuttle payloads, including those developed by other organizations such as Spacelab, Interim Upper State, Low Cost Modular Spacecraft, Long Duration Exposure Facility and Large Space Telescope.

In addition, the new facility will be responsible for JSC participation in international space activities, including any future joint activities with the USSR.

Dr. Fletcher Looks Ahead to Shuttle

Cites It as Most Exciting Project in Exclusive Interview with FASST

The days when people will be gathered on the beach to watch the Shuttle return were discussed recently by Dr. James C. Fletcher, NASA Administrator, in an exclusive interview with the Federation of Americans Supporting Science and Technology (FASST).

The subject came up in answer to a question as to what project in the space program excited him more than others. In the unmanned area, he mentioned continued exploration of Jupiter, but the Shuttle was his selection of the manned projects.

"I think the Shuttle is going to be pretty exciting," he said. "You know, not many people have actually seen astronauts land, and yet they will be gathered on the beach watching the Shuttle return. It will open a whole new world of things to do. We haven't even thought of them yet, but, once you start into operation, a lot of people will be thinking of new ways to use the Shuttle."

The interview was conducted by Leonard David, FASST Director of the Aerospace Youth Council. One of his first questions concerned whether there still existed a sense of exploration just for the sake of finding out what is on the next planet.

"Sure, it's around," Dr. Fletcher replied. "I would guess a large percent of the population would want us to go to Mars. The cost would be about the same as the Moon program. But I think it is not the majority yet and, as long as it continues not to be the majority, it is pretty hard to undertake a major mission of that sort. So, meanwhile, we are doing the exploration with unmanned spacecraft, and are doing a pretty good job. You can't do all the things you would like to, but we are covering quite a few planets already and we will be getting Saturn next and, who knows, maybe Uranus next. The latest is to fly right through the rings of Saturn. * * *"

Then he added:

"I would hate the footprints on the Moon to be thought of as the pinnacle of our achievement and to go downhill from there. But I must say that there is criticism or malaise among the academic community. I think that FASST is doing something to alleviate that. There is a general feeling among academic communities that technology is bad. Somehow that has got to be overcome."

Asked if the Shuttle could be used for future programs, such as space colonization, he replied:

"The colonization of space idea is a very exciting project to begin with, but I think it is too early to say that this is the direction that we ought to go. The costs are very large. You don't talk about very costly projects when there is trouble in the economy. Although it would be a great thing for employment, politically it is just very hard to push ahead, and I wouldn't want to without

studying it further.

"I think we will continue to lay plans for such a program. The main thing I don't like about it is the reasons for doing it. They say that they are concerned about our society pulling back from technology, becoming more or less like the Middle Ages, and that we ought to have a remnant of our technological society to be preserved out in space somewhere. * * * I personally think we ought to work harder preserving our technological society."

One of the last questions asked of him concerned extraterrestrial life.

"I think that there is other intelligent life in the galaxy," he replied, "and most scientists would bet on that. Some of it is probably nearby, and it would take a fairly sizable investment to listen in on the so-called 'Intergalactic Network.' For my money, I think it would be money wisely invested, but I suspect the average person when faced with the bill would not vote to put the money in.

"I would say the big uncertainty in it is not whether there is life out there, but rather, what are the chances that a technological civilization will survive. * * *"

Discussing space as a marketplace, he said: "It is just incredible when you start looking at the economics of the space program—how much return we actually do get. It is enormous, more than any other single investment that I know of in this country."

Frank Moore Appointed LaRC Procurement Chief

Frank V. Moore

Frank V. Moore, Assistant Chief of Procurement at Langley Research Center since 1973, has been named Chief of the Procurement Division, effective Sept. 1, replacing Sherwood Butler, who retired in June.

A Langley employee since 1962, Moore successively has been a Contract Assistant, Senior Contract Negotiator and Senior Contract Administrator. He became Head of the Contract Administration Section in 1970 and Assistant Head of the Research and Development Contracting Branch in 1972.

A native of Providence, RI, he earned a Bachelor of Science degree in 1962 and a Master of Business Administration in 1974 from the College of William and Mary. In 1969-1970, he attended Cornell University on a National Institute of Public Affairs/Career Educational

Commended by President—Two Flight Research Center employees, Merle A. Economu and Gerald J. Baker, recently received personal letters from President Ford commending them for their cost reduction suggestion involving a modification of film magazines used on research flights that will save the Federal Government $32,105 annually. Pictured here, standing left to right, are Dr. David Scott, FRC Director; Phil Hervey, Baker and Art Van Doren, Supervisor of the Instrument Construction and Repair Branch, in which the two men work. Economu is seated.

Award Fellowship.

He is a member of the National Contract Management Association, Hampton Roads Chapter, and is a past member of the American Society for Public Administration and the Society for Advancement of Management.

In 1967, he received a NASA Special Service Award for Achievement. He was Langley's Combined Federal Campaign Chairman in 1973.

Gens. Crow, Snavely Get New Assignments

Lt. Gen. D. L. Crow

Lt. Gen. Wayne Snavely

Lt. Gen. Duward L. Crow, USAF (Ret.), who little more than a year ago was named Assistant Administrator of the Office of DOD and Interagency Affairs and Special Assistant to the Administrator, has been appointed Associate Deputy Administrator, a position formerly held by Willis H. Shapley, who retired in August.

Gen. Crow will be succeeded as Assistant Administrator for DOD and Interagency Affairs by Lt. Gen. Wayne Snavely, USAF (Ret.)

Before joining NASA in September, 1974, Gen. Crow, a native of Fort Payne, AL, had been, since October, 1973, Assistant Vice Chief of Staff, the third ranking military official in Air Force Headquarters. In 1969, he served as Comptroller of the Air Force.

He was graduated from the U.S. Military Academy in 1941 and, during World War II, was assigned to the China-Burma-India Theater of Operations. After the war, he earned a Master's degree at the Harvard Graduate School of Business Administration and, in 1958, was graduated from the Air War College.

Born in Los Angeles, CA, Gen. Snavely was graduated from the U.S. Military Academy in 1943, earned a Master's degree in Business Administration from the University of Southern California at Los Angeles and attended the Advanced Management Program at Harvard University.

From August, 1962, to August, 1963, he attended the Industrial College of the Armed Forces at Fort McNair, Washington, DC, and was assigned to Air Force Headquarters as Deputy Director of Production, Office of the Deputy Chief of Staff, Systems and Logistics. In July, 1965, he was transferred to the Office of the Assistant Secretary of Defense (Procurement) as Director of Procurement Policy. He became Vice Commander, Oklahoma City Air Materiel Area in 1968 and the following year was assigned as Deputy Chief of Staff for Materiel Management, Headquarters Air Force Logistics Command at Wright-Patterson AFB, Ohio.

Gen. Snavely returned to Air Force Headquarters in December, 1971, as Assistant Deputy Chief of Staff, Systems and Logistics, and, in January, 1973, became Deputy Chief of Staff for Systems and Logistics.

'Sounding Rocket Day' at Goddard—Here examining rockets and other models are shown two of the more than 250 children and adults who recently attended the Fifth Annual Open House held by the Sounding Rocket Division of the Goddard Space Flight Center. Activities ranged from exhibits and demonstrations to advanced lectures on various aspects of sounding rocketry. One of the highlights was the actual flying of scale models made by members of the National Association of Rocketry.

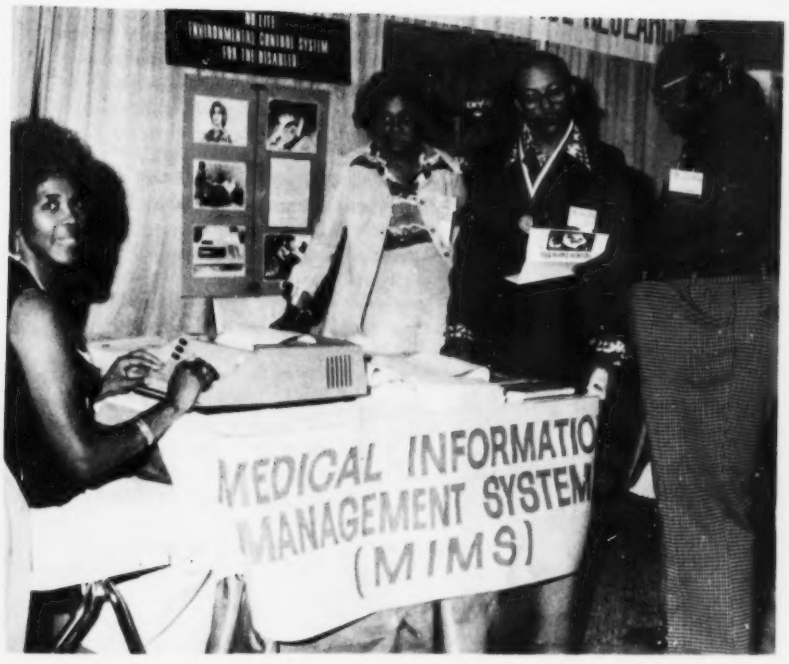


Exhibit for Doctors—Since the medical field has derived many innovations from space technology, NASA was one of the leading exhibitors at the recent 80th annual convention of the National Medical Association at Miami Beach, FL. Among those in attendance were, left to right, Kathleen Hipkins, GSFC Computer Specialist; Dr. E. Lavonia Allison, Director of the North Carolina Health Manpower Development Program; Dr. Jasper Williams of Chicago, newly-elected President of the Association; and Leon Perry, NASA Headquarters Information Officer.

Solar Collector, Bearing Design Win Award for LeRC

A low-cost, highly-efficient solar thermal energy collector and a ball bearing design with a 20-fold increase in life expectancy (see Your 1¢ Worth from NASA on last page) developed at the Lewis Research Center have earned Industrial Research Magazine's annual award as two of the 100 most significant new products turned out during the last year.

The collector, developed by Aerospace Engineer Frederick F. Simon of LeRC and James W. Ramsey of Honeywell, Inc., is composed of an efficient flow scheme, insulation, dual anti-reflective glass covers and, most importantly, a black chrome absorption coating, the most effective known. The last of these features has long been used as a decorative coating for metal furniture and other metal objects, but its use as an absorption coating is attributed to Glen E. McDonald of LeRC.

The two IR-100 awards received this year bring to 13 those won by Lewis since it first entered the competition 10 years ago. A thousand or more entries are received annually from industries throughout the country.

Two Major Headquarters Offices Realigned

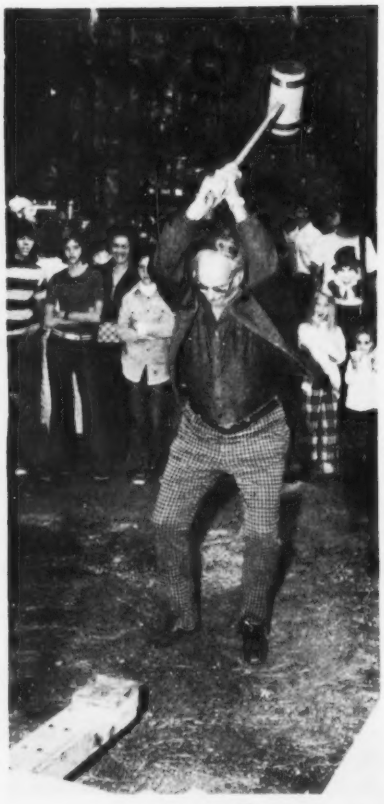
Preparing for future space flight operations with the Space Shuttle, NASA is realigning two of its Headquarters offices.

Dr. James C. Fletcher, NASA Administrator, announced that the Launch Vehicle and Propulsion Program in the Office of Space Science will be transferred to the Office of Manned Space Flight, while the NASA Directorate for Life Sciences, now in the Office of Manned Space Flight, will be transferred to the Office of Space Science.

Effective Sept. 28, the name of the Office of Manned Space Flight was changed to Office of Space Flight.

"The exchange of these program functions will provide a more logical alignment of responsibilities as we move into Space Shuttle operations," Dr. Fletcher said. "The new Office of Space Flight will be concerned primarily with launching space flights and conducting Shuttle operations, while Space Science will have responsibility for the science to be performed on these flights."

Annual Outing with a Bicentennial Theme —An estimated crowd of 5,000 attended the Marshall Space Flight Center's annual picnic and awards ceremony on Sept. 13, which featured a bicentennial theme in recognition of the nation's 200th anniversary. A gala parade led by U.S. Army soldiers in period uniforms dating back to the Revolutionary War kicked off the day's program. An arts, crafts and hobby display, in which employees and their families exhibited their work, was a big attraction.



Radio-Television

(Released Nationally)

TELEVISION: Two color film released in the *Aeronautics and Space Report* monthly film series: "Wind Power Research," (4½-minute and 90-second versions).

RADIO: Four weekly *Space Story* programs have been released. "Viking-Mars Mission," (Hdqrs./Jacobowski); "Viking Science Objectives," (Hdqrs./Dr. Young); "Reusable Space Shuttle," (Hdqrs./Malkin); "Viking Science Team," (Hdqrs./Hinners). One monthly *NASA Special Report:* "Viking Science Overview," (Hdqrs./Hinners).

Lunar Sample Exhibits

The following is a schedule of lunar sample exhibits from Oct. 15 to Nov. 15, 1975:

FLORIDA—Lighthouse Military Museum, Key West, Oct. 13-20; Hollywood Art Museum, Hollywood, Nov. 1
MINNESOTA—Zurah Flyers, Inc., Minneapolis, November
NEW YORK—Rensselaer County Junior Museum, Troy, Oct. 1-19
PENNSYLVANIA—Lycoming County Historical Museum, Susquehanna, Nov. 14-16
UTAH—Brigham Young University, Provo, Oct. 31-Nov. 14
AMERICAN FREEDOM TRAIN—Boise, ID, Oct. 15; Spokane, WA, Oct. 20; Seattle, WA, Oct. 24; Portland, OR, Nov. 4; Eugene, OR, Nov. 8; Reno, NV, Nov. 13
HIGH FLIGHT FOUNDATION-BICENTENNIAL MOBILE SPACE MUSEUM, Fredericksburg, VA, Oct. 14-19; West Virginia, Oct. 21-26; Paducah, KY, Oct. 28-Nov. 2; Corbin, KY, Nov. 4-9; Cleveland, TN, Nov. 11-16.

Long Term Displays

ALABAMA—Alabama Space & Rocket Center, Marshall Space Center, Huntsville
FLORIDA—Visitor Information Center, Kennedy Space Center
KANSAS—Eisenhower Library, 200 SE 4th Street, Abilene
NEW YORK—United Nations Building, New York City
OHIO—ISAF Museum, Wright Patterson AFB
TEXAS—Johnson Library, University of Texas, Austin; Visitor Information Center, Johnson Space Center, Houston
VIRGINIA—Visitor Information Center, Langley Research Center, Hampton
WASHINGTON, DC—National Geographic Museum; Smithsonian Institution, National Air and Space Museum, 1000 Jefferson Drive; Washington National Cathedral

Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces that the following U.S. patents have been issued by the U.S. Patent Office to NASA for invetnions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel for the indicated installation.

Inventor(s) and Employer(s)	Title and NASA Docket	Patent No.	Installation
Billy K. Davis, NASA/MSFC	Solar Energy Power System (MFS-21,628-1)	3,903,699	MSFC
Edward F. Baehr and Jack B. Esgar, NASA/LeRC, and William J. McGannon, self-employed	Ophthalmic Liquifaction Pump (LEW-12,051-1)	3,906,954	LeRC
Arthur S. Irwin, Marlin Rockwell Corp., Jamestown, NY	Drilled Ball Bearing with a One Piece Anti-Tipping Cage Assembly (LEW-11,925-1)	3,905,660	LeRC
Edward A. Maslowski, NASA/LeRC	Insulation Foil and Method of Making (LEW-11,484-1)	3,906,769	LeRC
Judd R. Wilkins, Albin O. Pearson and Stacey M. Mills, NASA/LaRC	Measurement of Gas Production of Microorganisms (LAR-11,326-1)	3,907,646	LaRC
Alexander Engel, Caltech/JPL	Symmetrical Odd-Modulus Frequency Divider (NPO-13,426-1)	3,906,374	NaPO
Robert H. Silver, Gilbert W. Lewis, Cyril Feldstein and Edward N. Duran, Caltech/JPL	Subminiature Insertable Force Transducer (NPO-13,423-1)	3,905,356	NaPO
Melvin M. Saffren, Caltech/JPL	A Doped Josephson Tunneling Junction for Use in a Sensitive IR Detector (NPO-13,348-1)	3,906,231	NaPO
Charles Elachi, Caltech/JPL	Acoustically Controlled Distributed Feedback Laser (NPO-13,175-1)	3,906,393	NaPO
Joseph Maserjian and George W. Lewicki, Caltech/JPL	Stored Charge Transistor (NPO-11,156-2)	3,906,296	NaPO
Victor A. Descamp, Michael W. Boex, Michael W. Hussey and Thomas P. Larson, Martin Marrietta Corp., Denver, CO	Filter Regeneration Systems (MSC-14,273-1)	3,907,689	JSC
Ray E. Marlow, Sperry Rand, Space Support Division, Huntsville AL	An Improved System for Enhancing Tool-Exchange Capabilities of a Portable Wrench (MFS-22,283-1)	3,907,312	MSFC
Robert L. McKenzie, NASA/ARC	Diatomic Infrared Gasdynamic Laser (ARC-10,370-1)	3,906,397	ARC
Gary R. Russell, Noble M. Nerheim and Thomas J. Piuirotto, Caltech/JPL	Inert Gas Metallic Vapor Laser (NPO-13,449-1)	3,906,398	NaPO
Ira S. Hoffman, NASA LaRC	Self-Supporting Strain Transducer (LAR-11,263-1)	3,906,788	LaRC

Projected Launch Schedule

(As of September, 1975)

Name	Launch Date	Vehicle	Range	Mission Remarks
Atmosphere-D	Oct. 6	Delta	WTR	A scientific satellite to investigate the chemical processes and energy transfer mechanisms which control Earth's atmosphere.
Navy	Oct. 8	Scout	WTR	Navy navigation satellite. Reimbursable.
SMS-C (GOES-A)	Oct. 16	Delta	ETR	First operational synchronous meteorological satellite of the National Weather Service of the Department of Commerce to provide continuous daytime and nighttime global cloud cover observations.
Atmosphere-E	Nov. 14	Delta	ETR	Scientific satellite to investigate the chemical processes and energy transfer mechanisms which control Earth's atmosphere.
Dual Air Density	Nov. 20	Scout	WTR	Two scientific spacecraft will be placed in orbit to obtain simultaneously measurements of the composition of upper and lower levels of atmosphere.
ITOS-E2	Nov.	Delta	WTR	Operational meteorological satellite of the National Weather Service to provide daytime and nighttime cloud cover imagery. Reimbursable.
Intelsat IVA-B	4th Qtr.	Atlas-Centaur	ETR	Second of a series of improved Intelsat Consortium satellites. Reimbursable.
RCA-A	4th Qtr.	Delta	ETR	First of a series of domestic communications satellites for RCA. Reimbursable.
Helios-B	(Under Study)	Titan IIIE-Centaur	ETR	Second West German/NASA cooperative satellite to investigate the properties and processes in interplanetary space close to the Sun.
1976				
CAS-C/CTS	January	Delta	ETR	Canadian-US cooperative experimental communications satellite to develop and test the technology of high power satellite communications systems.
LAGEOS	1st. Qtr.	Delta	ETR	Demonstrate relevant space techniques that will contribute to the development and validation of predictive models for earthquake hazard alleviation, ocean surface conditions and ocean circulation.
NATO-C	1st. Qtr.	Delta	ETR	Communications satellite in synchronous orbit to perform communications relay for NATO. Reimbursable.
RCA-B	1st Qtr.	Delta	ETR	Second domestic communications satellite for RCA. Reimbursable.
Relativity (Gravity Probe)	(Under Study)	Scout	WI	Scientific satellite to make a test of Einstein's Theory of Relativity.
Marisat-A	(Under Study)	Delta	ETR	Comsat Corp. satellite to provide maritime satellite communications services. Reimbursable.
Comstar-A	1st Qtr.	Atlas-Centaur	ETR	Domestic communications satellite for Comsat Corp. Reimbursable.
Intelsat IVA-C	1st Qtr.	Atlas-Centaur	ETR	Third of a series of improved Intelsat Consortium satellites. Reimbursable.
Marisat-B	2nd Qtr.	Delta	ETR	Second Comsat Corp. satellite to provide maritime satellite communications services. Reimbursable.
Westar-C	(Under Study)	Delta	ETR	Backup domestic communications spacecraft for Western Union. Reimbursable.
Comstar-B	2nd Qtr.	Atlas-Centaur	ETR	Second domestic communications satellite for Comsat. Reimbursable.

Indonesia-A	3rd Qtr.	Delta	ETR	Indonesian communications satellite. Reimbursable.
RCA-C	2nd Half	Delta	ETR	Third domestic communications satellite for RCA. Reimbursable.
SIRIO-A (Italy)	4th Qtr.	Delta	ETR	Italian project to investigate radio propagation, trapped radiation flux, magnetic field intensity and variation, and the primary electron energy spectrum. Reimbursable.
GOES-B	4th Qtr.	Delta	ETR	Second operational satellite to provide continuous daytime and nighttime global cloud cover observations for NOAA. Reimbursable.
ITOS-H	4th Qtr.	Delta	ETR	Operational meteorological satellite to provide daytime and nighttime cloud cover imagery for NOAA. Reimbursable.
Comstar-C	4th Qtr.	Atlas-Centaur	ETR	Domestic communications satellite for Comsat. Reimbursable.

Production Planned—The new, improved firefighter's breathing system developed from aerospace technology and described in "Your 1 Cent Worth from NASA" in the July, 1975, issue of NASA ACTIVITIES, will be produced under the name of Scott Air-Pak 4.5 by the Scott Aviation Co., Lancaster, NY. Announcement to this effect was made at the recent annual meeting of the International Association of Fire Chiefs at Las Vegas, NV.

New EEO Counselors Get Certificates— Dr. William R. Lucas (center) Director of the Marshall Space Flight Center, is shown as he recently presented certificates to four new equal employment opportunity counselors. Left to right, they are James J. Graham, Robert E. Shurney, Billie DeGlopper and Ruth von Saurma.

NASA Tech Briefs

The Technology Uilization Office, NASA Headquarters

The following is a listing of published NASA Tech Briefs. Inquiries concerning them should be directed to the TU Office of the originating NASA Center.

Innovator(s)	Title	Number	Center
W. K. Dahm and R. M. Huffaker, MSFC, and A. V. Jelalian, D. J. Delgrego, I. Goldstein, W. H. Keene, P. A. Miles and C. M. Sonnenschein, Raytheon Co.	Laser System Detects Air Turbulence	B73-10210	MSFC
Kenneth W. Billman, ARC	Infrared Tunable Laser—A Concept	B75-10081	ARC
John Dimeff, ARC	A Nondispersive Infrared Analyzer	B75-10082	ARC
Martin Hudis and Theodore Wydeven, ARC	Dielectric Films Improve Life of Polymeric Insulators	B75-10084	ARC
David K. Studenick, Allen L. Tyler and Walter Squillari, GSFC	Torque Control System	B75-10085	GSFC
Donald C. Lokerson and Howard G. Holby, GSFC	Techniques for Decoding Speech Phonemes and Sounds: A Concept	B75-10086	GSFC
A. E. Siegman, Stanford University	Antiresonant Ring Interferometer for Laser Cavity Dumping, Mode Locking, and Other Applications	B75-10087	NASA Hdqrs.
Herbert M. Aumann, University of Wisconsin	One-Dimensional Multimode and Multistate Oscillator: A Concept	B75-10088	NASA Hdqrs.
Benjamin P. Pisciotta, Chris Gross and Rudolph S. Olive, LaRC	Sputtered Gold Mask for Deep Chemical Etching of Silicon	B75-10089	LaRC
John M. Franke, LaRC	Holographic Direct-Vision Spectroscope	B75-10090	LaRC
John M. Franke, LaRC	Dual-Band Ridged Waveguide	B75-10091	LaRC
Ray W. Lovelady and Robert L. Ferguson, LaRC	Miniature Sonar Fish Tag	B75-10092	LaRC
D. Johnson and C. Brown, MSFC, and D. Spiegler and M. Fowler, Environmental Research & Technology	Four-Dimensional Worldwide Atmospheric Models: ANYPT and ANYRG	B75-10093	MSFC
J. Key, MSFC, and V. Svalbonas, Grumman Aerospace Corp.	Computer Program for Numerical Analysis of Stiffened Shells of Revolution	B75-10094	MSFC
W. A. Vachon and J. M. Dahlen, Charles Stark Draper Laboratory, Inc.	Simple and Effective Method to Lock Buoy Position to Ocean Currents	B75-10095	MSFC
T. M. Edge, MSFC	Interactive Graphical Computer-Aided Design System	B75-10096	MSFC
P. N. Peters and L. B. Holderman, MSFC	Superconducting Quantum-Interference Devices	B75-10097	MSFC
L. W. Brantley, MSFC	Large-Scale Solar Thermal Collector Concepts	B75-10098	MSFC
W. C. Stewart, RCA Corp.	Dichromated-Gelatin Hologram Process for Improved Optical Quality	B75-10099	MSFC
R. G. Vos, The Boeing Aerospace Co.	Program for Analysis of Nonlinear Equilibrium and Stability (PANES)	B75-10100	MSFC
L. E. Dickens, F. G. Tragester and H. B. Kim, Westinghouse Electric Corp.	High-Performance Schottky Diodes Endure High Temperatures	B75-10101	MSFC
L. E. Dickens, Westinghouse Electric Corp.	Integrated-Circuit Balanced Parametric Amplifier	B75-10102	MSFC
R. A. Easton, Hughes Aircraft Co.	Central Control Element Expands Computer Capability	B75-10103	MSFC
L. J. Leger, JSC	Method of Attaching Insulation Tiles	B75-10104	JSC

Specialist in Minority Programs— Katherine E. Richter, a former program and management analyst, is an equal opportunity specialist who researches a myriad of reports and manpower statistics to determine whether equal opportunity goals have been met by the Marshall Space Flight Center. Her work, which spotlights problem areas or situations which might be developing, is helpful to management in setting policy and developing equal opportunity programs.

A. Miller, RCA Corp.	Wide-Field Birefringent Elements	B75-10105	JSC
G. W. Hoffler, JSC, and D. P. Golden and R. A. Wolthuis, Technology, Inc.	Computer Program for Analysis of Vectorcardiograms (VECTAN II)	B75-10106	JSC
R. L. Beavin and A. I. Simanyi, McDonnell Douglas Corp.	High-Efficiency K-Band Tracking Antenna Feed	B75-10107	JSC
K. P. Joncas, S. Birnbach, L. D. Bruce and L. Smith, Avco Corp.	High-Power AC/DC Variable Load Simulator	B75-10108	JSC
C. C. Oleson and A. D. Vidana, Rockwell International Corp.	Fluorescent Color Coding of Power Receptacle	B75-10109	JSC
G. Lerma, Rockwell International Corp.	Cryogenic Line Insulation Made from Prefabricated Polyurethane Shells	B75-10110	JSC
J. F. Parker and R. L. Robbins, Rockwell International Corp.	Powered Fire Nozzle for Fast Penetration of Structures: A Concept	B75-10111	JSC
Joseph Maserjian, Caltech/JPL	Laser Scanned Image Sensors Using Photoconductors with Deep Traps	B75-10112	NaPO
Marshall F. Humphrey, Caltech/JPL	Processing for Obtaining Good Quality Water from Sewage	B75-10113	NaPO
William J. Hurd and Richard M. Goldstein, Caltech/JPL	Quasars as Very-Accurate Clock Synchronizers	B75-10114	NaPO
James B. Laudenslager, Caltech/JPL	Chemical-Ionization Visible and Ultraviolet Gas Lasers: A Concept	B75-10115	NaPO
Taylor G. Wang, Melvin M. Saffren and Daniel D. Elleman, Caltech/JPL	Heat-Operated Cryogenic Electrical Generator	B75-10116	NaPO
Alan Rembaum, Shiao Ping S. Yen and Elias Klein, Caltech/JPL	Improved Ion Exchange Membrane	B75-10117	NaPO
Melvin M. Saffren, Caltech/JPL	High-Energy Lasers by Using Distributed Reflection: A Concept	B75-10118	NaPO
Richard J. Stirn and Yea-Chuan M. Yeh, Caltech/JPL	Laser-to-Electricity Energy Converter for Short Wavelengths	B75-10119	NaPO
Randall K. Kirschman, James E. Mercereau and Harris A. Notarys, Caltech/JPL	Microelectronic Fabrication of Superconducting Devices and Circuits	B75-10120	NaPO
Alan Rembaum, Marylou Ingram and Agnes Stroud-Schmink, Caltech/JPL	Ionene Treatment of Surfaces Stimulates Cell Growth	B75-10121	NaPo
Cecil P. Wiggins and Richard L. Leu, Caltech/JPL	Transmitter Switch for High-Power Microwave Output	B75-10122	NaPO
Che J. Chen, Nobel M. Merheim and Gary R. Russell, Caltech/JPL	Double-Discharge Copper-Vapor Laser	B75-10123	NaPO
James B. Stephens and Eric G. Laue, Caltech/JPL	Quartz Crystal Microbalances to Measure Wind Velocity and Air Humidity	B75-10124	NaPO
Richard J. Stirn, Caltech/JPL	Schottky Barrier Solar Cell Promises Improved Efficiency	B75-10125	NaPO
Robert C. Clauss and Erwin R. Wiebe, Caltech/JPL	Transmission Line for S-Band Masers	B75-10126	NaPO
Charles Elachi, Gary A. Evans and Cauvour Yeh, Caltech/JPL	Laser Action Generated Within a Light Pipe: A Concept	B75-10127	NaPO
Che J. Chen, Caltech/JPL	Laser Using Lead Chloride Vapor	B75-10128	NaPO

Congressman Visits MSFC Solar House—Dr. William R. Lucas (left), Marshall Space Flight Center Director, explains use of flat conductor cable in home wiring to Representative Bob Jones of the Alabama Fifth Congressional District, who recently visited the Solar House at MSFC because of his interest in employing solar heat for heating and cooling.

Inventions and Contributions Board Monetary Awards

The Inventions and Contributions Board, at its meetings of Sept. 25, Oct. 31 and Dec. 19, 1974, recommended that monetary awards be granted to the NASA employees and NASA contractor employees identified on the attached list for scientific and technical contributions to space and aeronautical activities. The recommendations were approved by the Administrator and the awards have been made.

Innovator(s)	Title of Invention and Contribution
AMES RESEARCH CENTER	
Dean R. Harrison John Dimeff	Diode-Quad Bridge Circuit
John Dimeff William J. Kerwin	Integrated Structure Vacuum Tube
Wayne H. Howard Donald R. Young Richard R. Adachi	Programmable Physiological Infusion
Grant W. Coon	Trielectrode Capacitive Pressure Transducer
GODDARD SPACE FLIGHT CENTER	
Anthony J. Caruso John Zaniewski	Holographic Grating Evaluation
Meredith W. Wilson	Wired Extensometer
Leo J. Veillette	Axially and Radially Controllable Magnetic Bearing
George T. Clawson	Method and Apparatus for Checking Fire Detectors
John B. Schutt	Ultraviolet Light Reflective Coating
Stanford Ollendorf	Structural Heat Pipe
Rodger A. Cliff	Digital Phase-Locked Loop
JOHNSON SPACE CENTER	
Leo G. Munford, Jr.	Digital Communication System
Leo G. Munford, Jr.	Binary Concatenated Coding System
Herbert S. Kabayashi	Pulse Code Modulated Signal Synchronizer
KENNEDY SPACE CENTER	
Francis Byrne	Digital Servo Controller
LANGLEY RESEARCH CENTER	
Carl V. Rumble	Means for Accommodating Large Overstrain in Lead Wires
Wayne D. Erickson Edward M. Sullivan	Ablation Artical and Method
Peter B. Mumola Belton T. McAlexander	A Laser Head for Simultaneous Optical Pumping of Several Dye Lasers
Eugene C. Naumann Gideon G. Hagood	Vibration Mode Synthesizer
Thomas A. Blackstock	Ferry System
LEWIS RESEARCH CENTER	
Andrew Terpay	Method of Making an Apertured Casting

Tito T. Serafini Peter Devigs Raymond D. Vannucci	Fabrication of Polyphenylquinoxaline Composite Articles
Paul R. Prokopius	Flow Measuring Apparatus

MARSHALL SPACE FLIGHT CENTER

Billy K. Davis	Solar Energy Power System
Edwin E. Klingham, III	Electronic Optical Transfer Function Analyzer
Philip W. Tashbar	System for Depositing Thin Films
Edwin E. Klingham, III	Recognition System for Type II Robots
James C. Billions John L. Burch	Speed Calculator
Frank J. Nola	A Variable Frequency Inverter for AC Induction Motors

U.S. ARMY ENGINEERS DISTRICT

Carl L. Canicatti	Voltage Monitoring System

BELL AEROSPACE CORPORATION

James R. McChesney Theodore Lerner Ernest J. Fitch	Modulator for Tone and Binary Signals

BOEING COMPANY

Karl W. Merz Alton L. Morrell	Technique for Measuring the Dynamic Linearity of an FM Subcarrier Oscillator and FM Discriminator

CELESCO INDUSTRIES

Parameswar Mahadevan Raymond L. Chaun	Method and Apparatus for the Detection of Nitric Oxide

GULF SOUTHERN RESEARCH INSTITUTE

Elias Klein	Ion-Exchange Hollow Fibers

MARTIN MARIETTA CORPORATION

Dan Padilla	Fiber Separating and Cleaning Method and Apparatus

McDONNELL DOUGLAS CORPORATION

Dallas G. Wetzler	Thrust-Isolating Mounting
Clifford Burdin	Phase-Locked Servo System

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Antonia F. Bellemo	Monostable and Astable Multivibrator Apparatus

MODERN MACHINE AND TOOL COMPANY

Kenneth L. Driscoll	Means for Accommodating Large Overstrain in Lead Wires

Are you getting your **1 cent** worth from **NASA**?

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Greatly Improved Ball Bearings

Researchers at the Lewis Research Center, working in cooperation with others from the General Electric Co., Cincinnati, OH, and Industrial Tectonics, Inc., Compton, CA, have developed a ball bearing that has a proven life expectancy 20 times greater than the best ball bearing now in use in large gas turbine engines.

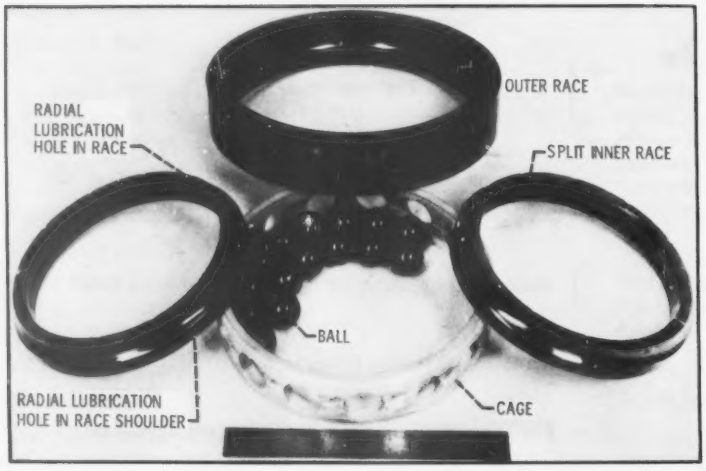
This development is considered by technology experts the most significant improvement in high-speed ball bearing design in recent decades. Rating it one of the most significant new products developed during the last year, Industrial Research Magazine, as a token of recognition, presented LeRC with its annual award.

Advanced bearings of this type are expected to replace the current mainshaft thrust ball bearings now used in large turbine engines.

The bearing was designed by using computer analysis to obtain maximum performance and reliability. Advanced, commercially-available steel and steel melting techniques were employed to provide a cleaner and longer-lived material for the bearing. Great and more accurate surface finishes on the bearing rings were obtained through vastly improved fabrication and machining methods.

Lubrication is obtained through holes in the bearing's split inner ring instead of by using conventional lubricant jet-pointed at the rings.

The advanced design promises to provide reliable, long-life bearings for users of large gas turbine engines and of pumping systems such as aircraft engines, electric utilities petroleum pipeline operations, and numerous others.



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